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Just as I predicted a couple of decades ago (if I do say so myself), fuel injection has taken over. So much so in fact that you can't buy a new car today equipped with the traditional means of mixing air and fuel. So why a carb section at this late date?

Simple: If you were to limit your fuel system knowledge to FI only, you'd be uninformed about half the cars out there. Because the average age of the automobiles on the road is eight years or so, there are still many millions of carbureted vehicles in our highway population. A large percentage of these aging conveyances have fallen out of the professional repair realm into the care of do-it-yourselfers, and I figured a review would help you cope during this period of transition and upheaval in fuel systems.

Leery of theory?

I fondly remember my experience a couple of decades ago when I first learned carburetion theory. Plenty of lights went on and connections were made to problems I'd seen, but had really understood. Thereafter, I had a great deal more success troubleshooting driveability and performance complaints than before my enlightenment. I'm a firm believer in the value of scientific knowledge in automotive diagnosis, so I strongly suggest you go back and read the preceding section on carb theory for a quick, painless review of carb principles that you can apply to any specimen, regardless of who made it or when.

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Big bucks and false witness

A couple of general observations are appropriate here. First off, it doesn't seem like that many years ago when a brand new carburetor was reasonably affordable. If you ran into a specimen that had serious problems, you could simply take this replacement route and feel you'd done the most practical thing. No more. It's not uncommon to see a price of $800 today, with quite a few examples up over a grand.

As you should know by now, carburetors are often mistakenly blamed for various troubles remember a slant six showing up in my shop that had had four different carbs installed by others, yet continued to exhibit starting and driveability problems (the real culprit was a combination of an ignition glitch and a vacuum leak to #6). Examples of this sort of thing abound: The mix master is wrongly accused when coked-up heat risers, a malfunctioning heated air intake system, bad plugs, etc. are actually causing the symptoms. One quality remanufacturer claims that 70% of the carburetors it gets back as returns are actually oka

I believe the reason is that a carb is an intricate, complex mechanism that's not always we understood. It's sort of like the situation with computerized engine controls: Because they' present and require considerable mental discipline to diagnose, people tend to jump to the conclusion that they're the source of the complaint, which results in perfectly good (and expensive) modules and sensors being replaced when the fault is really something much more basic

more basic.

On the other hand, air/fuel mixers are indeed prone to many ailments, some terminal. So, you've got to maintain a balance of mind while troubleshooting. The old shotgun approach of replacing things until the problem goes away has never been acceptable, but is much less so today at these prices.

Unless the problem is obvious (an overflowing bowl, perhaps, or a lack of accelerator pump output), you've got to eliminate the other possibilities before you condemn a carb. Otherwise, you're shotgunning, which is an expensive and frustrating sport.

Floats that won't

Maybe you remember the plague of gasoline-soaked foam floats that caused seriously over-rich running back in the seventies. Apparently, it's not entirely over. A tech expert with a company that supplies replacements told me, "Heavy floats are still occurring, and new float sales are still high. It seems that as soon as the carburetor makers change the type of foam, there's a new gasoline additive that defeats it."

When you encounter a heavy float, you often have a choice of replacements. You can buy nitrophyl (the generic term for the closed-cell foam used in floats), or the brass pontoon-type. Technicians frequently request the latter, quite logically assuming that there's no chance they'll soak up fuel. But they aren't necessarily invulnerable -- anything that's sealed can leak. As one parts maker said, "We carry both brass and foam. When brass fails, it's catastrophic -- gas flowing out of the carburetor, maybe a fire -- whereas with foam it's gradual degradation of how the car runs." My opinion? Use what's readily available from a reputable source.

Feedback

The feedback carburetor was never all that satisfactory -- a relic of the mechanical age trying to make it in the electronic era. It has all the frailties and drawbacks of a regular carburetor, with the additional complications of a remotely-controlled mixture system. The number of connections to the carb can make you crazy -- a typical specimen has eight vacuum nipples and four electrical terminals. There's a good chance you'll be seeing problems with such an animal, so read the next section on feedback carbs.

VV land

The Motorcraft Variable Venturi carb, which was used on various '77 through '82 Fords, gives great response and efficiency. That is, when it's working.

Its main weakness is that big vacuum diaphragm, which tends to rupture. That results in ultra-rich running, a fouled O2 sensor, and perhaps even an over-filled crankcase from gasoline dilution. An approved modification that'll make the diaphragm last longer is to drill a drain hole in the bottom of the cavity 1/8 in from the gasket surface with a #46 (.081 in.) bit. This eliminates the nasty fluids that eat up the rubber.

Another common problem with the 7200 version is a jammed stepper motor that won't respond to computer commands. You may be able to free it up with electrical contact cleaner.

An R&D engineer at a company that makes carburetor repair components gave me a good tip: "When you pull the top off a VV, don't disassemble it and throw it into the solvent. Instead, use spray cleaner so you don't have to remove the enrichment rod levers, etc. That way, there'll be much less to adjust." Actually, the idea of doing no more disassembly than necessary can be applied to any carb.

FUBAR and reman

We've all seen carburetors that fit the acronym "FUBAR" (Fouled Up Beyond All Repair). Serious corrosion, throttle shaft bore wear, broken castings, etc. mean they can't be fixed with ordinary parts or tools.

A trip to the wrecking yard is a possibility, but it's often fruitless and always time-consuming. A new unit can be unbelievably expensive. So, how about a remanufactured replacement?

If you're like most of us who've been working on cars for a while, you've had traumatic experiences with rebuilt carbs sometime in the distant past. And maybe you still avoid them. I understand. But that's really an outmoded attitude today where quality brand-name remans are concerned. I'm not talking about one guy working in a tumble-down shop with a screwdriver and buckets of spare parts. I mean responsible companies with national distribution. For example, one I know of has 550 employees, including full-time carburetion engineers, 200,000 sq.ft. of space, and the capacity to turn out 4,000 units daily. It also has a free tech hotline that handles 100-200 calls every working day. The technical services manager of this outfit told me, "With all we do to the cores we get, we should actually be considered a manufacturer. Our raw material is old, screwed-up carburetors." They wet-flow test every unit before it goes out, too, so quality control is excellent, and the settings are already pretty close when you bolt it on.

Reman carbs definitely reduce financial shock, and as long as you go brand name you don't have to be afraid of them anymore.

Oops

As you may have learned the hard way, it's easy to strip fuel inlet threads. Fortunately, repair fittings and kits are available to rectify the situation. There's the self-tapping type that's been around for years. It works by cutting new threads and going deeper into the housing. If you've got a case that's beyond that, there's also the type that uses O-rings that seal against the inside of the inlet bore. It's held in place by a set screw.

On Quadrajets, the threads that hold the fuel inlet valve are sometimes ruined, but there's an aftermarket valve assembly with O-rings that'll take the sting out of this tragedy.

Those fine threads for the lean mixture adjusting screw (at the feedback M/C solenoid) in Rochester Dual Jets and Quadrajets are frequently destroyed in service, too, but there's an easy fix that includes a knurled repair stud that's driven into the carb body and an adjusting cap with female threads.

Speaking of mixture control solenoids, you may be familiar with the tiny O-ring and its brass retainer that reside at the end of the plunger on a typical E2SE. They have to be removed to vacuum test the unit, and they can come off and stop up the orifice. What to do? Well, instead of buying a new solenoid (over $70), you can get a repair kit.

You know those little brass cup plugs in the secondary metering well of a Quadrajet? They tend to leak. Machined aluminum replacements with o-rings are available, and there are also thick rubber-like seals that fit tightly into the cavity in the carb base and press against the underside of the well.

While I'm on the subject of GM carbs, I should mention one successful shop owner's approach to poor driveability in late models. He told me, "Since a high percentage of our customer base is GM, we've been hearing plenty of C3 carburetor complaints, such as poor cold running, surging, and lack of power -- maybe two per week. It's almost standard for us to clean them out and do all the internal adjustments from float level and metering rods to knocking out the plugs and resetting the mixture. Then they run like a charm." Unfortunately, everybody hasn't had such pleasing results. Some technicians I've talked to say the only remedy for a lean fuel curve in certain cases is a switch to different rods or jets.

Legal aliens

Now for some specific info on imports you won't find elsewhere. If you ever get a carbureted Toyota that runs way too rich while cold, it's not necessarily due to an incorrect choke setting or a faulty vacuum pull-off. Ken Creel, owner of an independent shop in Florida that specializes in Toyota only, told me, "Something I see often, and make quite a bit of money on, is a bad AAP (Auxiliary Acceleration Pump). We just had one today, and another shop had replaced the EGR valve and was talking about modifying the carburetor. The symptoms are black smoke while the engine's warming up and a #1 plug that's a lot darker than the others. The exhaust clears up once normal operating temperature is reached. What happens is the vacuum-operated diaphragm for the pump starts to leak, and the vacuum hose, which is connected to #1 cylinder's intake manifold runner, fills up with raw gas. When the temperature/vacuum switch on the engine closes, the gas can only go as far as the switch, so the smoke stops even though the diaphragm is still leaking. We used to buy whole carb rebuilding kits to fix this, but now you can just get the diaphragm from Toyota. It's part number 21667-38011. Just remember to always check that hose for the presence of gasoline."

Nissans seem to be especially prone to lean hesitation problems. In cases where there's a bulletin, substituting the slightly richer "countermeasure" components will often mitigate matters, but there are also bootleg cures such as drilling jets to a modest degree. As one expert, who shall be nameless, said, "Oftentimes, a small modification will change a car that's a pain to drive and that the owner is ready to get rid of into a fine-running vehicle."

The opposite condition in Nissans, richness that causes rough running, can show up when gasoline formulated for winter use is still sold in hot weather (this is especially critical at high altitudes). For '80-'82 210's and 310's and other, earlier models, a needle and seat kit and, in some cases, a new fuel pump and/or pump cam are available to cure this unpleasantness.

One shop owner mentioned a simple thing that's sometimes overlooked: "Maybe six times this month with Nissans we've seen the little filter screen under the needle valve get clogged, and after five or ten miles it's like you ran out of gas."

On most Nissan models with feedback carburetors, there's an easy way to determine if stumble or hesitation comes from the electronics or the carb's innards. Simply disconnect the wire to the duty solenoid. If the problem vanishes, the brain or its sensors or wiring is at fault. If the same condition continues, you'll have to get inside the air/fuel mixer.

There are a couple of important cautions to observe when rebuilding Nissan carburetors. First, on some models there's a plastic restrictor in the accelerator pump inlet hole. If your solvent is too caustic, it'll melt the restrictor into a blob that'll stop flow entirely, and you'll get the symptoms associated with a bad pump. You can remove the welch plug and drill out the passage -- you'll find plastic on the bit. Also, there are O-rings sealing the main circuit on certain designs, and if you soak the unit long enough to damage these circular seals, the result will be an extra air bleed and lean running. Getting the right replacement O-rings can be difficult.

SOP for CVCC

How about Honda? Well, that unusual CVCC carb has inspired plenty of trepidation among technicians. Remember the tip that was going around for years about never turning a Honda carb upside down? It's true. As Scott Lightsey, owner of a Florida shop that specializes in Japanese cars, told me, "They do not like trash, period. They have very small orifices throughout." He recommends replacement of both the regular fuel filter (by the tank) and the "separator" (what Honda calls its ordinary in-line filter) at every tune-up. On older models without the separator, he installs a universal auxiliary filter.

There was a plague of sinking floats when Honda went to hollow plastic units in the early eighties. You couldn't see any cracks, but they were full of gas nevertheless. Lightsey told me he had up to 10 cases a day in his shop. Now, he rarely encounters them. The company established an extended warranty to cover this situation (7 years or 75K miles), but it ran out way back in '89 for the last cars covered.

Whenever you have occasion to rebuild a Honda carburetor, note that the idle mixture screw carries a tiny o-ring, which is commonly overlooked. It can get jammed in the hole and shut off fuel flow. Lightsey says he reuses the old o-rings if they're in good shape because the new ones included in most rebuilding kits aren't exactly the right size. Ditto for those that seal the power valve and the accelerator pump cover. Coat them with Vaseline or equivalent.

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VI. Carburetion

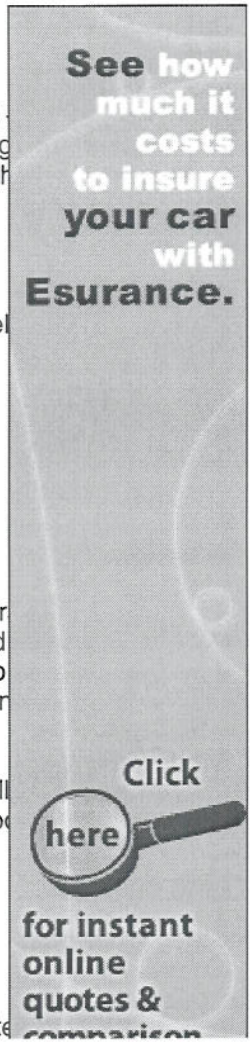
C. Feedback Feedback: Those Troublesome Electronically-Controlled Carbs

Call it a compromise, stop-gap, interim solution, or crutch, the feedback carburetor was never all that satisfactory, a relic of the mechanical age trying to make it in the electronic era. Quaintly obsolete, it had all the frailties and drawbacks that carburetors are heir to, w the additional complications of a remotely-controlled mixture system. The number of vacuum and electrical connections to the carb became downright ridiculous. The confusion of the underhood environment was enough to make any technician dream of early retirement. Just compare the engine compartment of an early-80's feedback carburetor-equipped car to that of a later model with EFI. That's progress we can all appreciate.

Speaking of injection, for many, many years I've been predicting that that supremely accurate means of metering gasoline would supplant the carburetor. It's finally happened - all new vehicles now sold in this country are so equipped. But huge numbers of cars using feedback carbs are still on our roads. One thing can be said for them: They got us through a difficult transition period to more stringent emission standards, providing good enough mix control to allow the three-way cat to its job.

When you trace a problem to an electronic feedback carburetor, you won't be doing yourself a favor by just automatically replacing it. Not at these prices -- a typical two-barrel lists for an earth-shaking $800! Even remanufactured versions cost maybe $500.

Given these expensive circumstances, there's little doubt that you'll be fixing these late model carbs whenever possible rather than just taking the simple route and bolting on a new or refurbished unit.



Biting the bullet

Yeah, I know. The whole subject is intimidating. I have to admit to a little trepidation the fir time I took one apart. But I found that once I'd disconnected the, oh, two or three hundred vacuum lines and electrical connections, and had the carb on the bench, it didn't seem so scary or mysterious anymore. Just a modern carburetor with some logical-looking additior

Fortunately, many of the basic troubles that mechanical air/fuel mixers have traditionally been heir to (say, a soggy float, a leaky needle and seat, or a faulty accelerator pump) will still be repairable with the same general procedures you've always used. Some other good news is that a lot of the stuff I'm going to talk about here can be serviced with the carb mounted on the engine.

On the other hand, there's some new hardware to deal with, such as mixture control solenoids, throttle position sensors, temperature-controlled accelerator pump bypasses, stepper motors, idle air control valves, etc., and a number of unfamiliar adjustments too. Since I can't give you detailed info on all the specimens out there, I decided to concentrate

on one of the most common electronic carburetors in our vehicle population: the Rochester VaraJet II (E2SE), a staged two-barrel which you'll find perched atop certain GM engines (my example came off an '84 2.8 liter Chevy V6). I'll give you a quick course on a few of the jobs you're likely to run into.

A note on electrical readings: You can get the necessary data remotely through the ALDL (Assembly Line Diagnostic Link) using a scan tool, but I'll give direct tests, for which you'll need a digital multi-meter with sufficient impedance to ensure against frying the ECM, and an ordinary dwell meter (hey, who'd have thought you'd ever need that again?).

No conclusion-jumping

As has always been the case, before you start tampering with the carburetor, make sure you're not bearing false witness against it. In the past, this meant a simple examination of the ignition system and maybe compression. Now, of course, unless the problem is obviously in the carburetor (an overflowing bowl, perhaps, or a lack of accelerator pump output), you've got to check out the sensors and the other electronics (in this case, the C-3 system) before you condemn a carb, but that's another story. Suffice it to say here that if the computer and its network of assistants and wiring are okay, there are no vacuum leaks or linkage troubles, and emissions controls such as the heated air intake and EGR are working properly, the carburetor is the likely culprit.

I should mention two preliminaries: Make sure you've got the proper Torx drivers, and put some feet on the mounting flange ears to protect the throttle plates (four bolts with two nuts each work fine).

Blend controller

Now, suppose you're confronted with symptoms that point to a faulty air/fuel ratio. Do you start by breaking out the steel anti-tampering plug and twisting the mixture screw? Not if you're smart you don't. That factory setting is probably correct, and if you don't want to go through a lot of gyrations trying to get it back where it belongs, look into more likely causes of the condition. Clogged passages could be the problem, but you check for them in every carburetor you disassemble, right? That's nothing new, but electronic mixture control is, and it's easy to test. Providing you got the proper dwell readings during your initial check-out, the mixture control solenoid itself should be suspect. Proceed as follows:

1. Remove the solenoid from the air horn and take the rubber seal, retainer, and spacer off the end of the solenoid stem.
2. Attach a hand-operated vacuum pump to the solenoid stem, then connect a jumper wire between either electrical terminal and a 12 volt positive source. Hook another jumper between the second terminal and negative.
3. Apply 25 in. Hg. The factory info says to time the leak-down rate from 20 to 15 in. Hg., and that if it loses those five inches in less than five seconds to get a new solenoid. I hate to disagree with holy writ, but it's been my experience that perfectly good specimens leak down very quickly once the vacuum reaches 20, so I time them from 25 to 20, which they've all done in about five seconds.
4. Remove the jumper wires to de-energize the solenoid and watch the vacuum gauge. It should go to zero in less than one second. If it doesn't, it's sticking in the down position and should be replaced.

If the solenoid's okay, check the metering jet for looseness, damage, or dirt.

While I strenuously recommend against tampering with the mechanical mixture settings, there will be cases where all your testing brings you to the unfortunate but unavoidable conclusion that they must be changed (maybe somebody else has fooled with them), and there's only one way to do it right:

1. With the manifold side up, saw two parallel slots in the throttle body so that they meet the idle mixture screw plug.
2. Using a flat punch at a 45 degree angle, crack off the tab you've created in the

casting, then break out the plug.
3. Turn the screw in until lightly seated (it has a "Double-D" head that can be turned by wedging a screwdriver in next to it, but it would make things easier if you either buy a special tool, or fabricate your own by partially flattening a piece of tubing or cutting a notch in the end of a 1/4 in. bolt), then back it out four turns.
4. Remove the screen from the vent stack in the air horn to get at the lean mixture screw (it too has a "Double-D" head, but smaller). Seat it, then back it out two and a half turns.
5. Mount the carb on the manifold, but don't connect the bowl vent line or the EGR and canister purge hoses. Instead, cap the ports on the carburetor. Plug the port that supplies vacuum to the air cleaner temperature sensor also.
6. Connect the + clip of a dwell meter to the mixture control solenoid's blue wire (slip a stiff wire into the back of the plug as a tap), and the - clip to ground. Set the meter for six cylinders. Hook up a tach too (use the brown distributor lead).
7. Run the engine until the coolant fan comes on.
8. Hold the rpm at 3,000, then watch your dwell meter while turning the lean mixture screw -- you want 35 deg. If it's too low, back the screw out, and vice versa. You'll get a reading drift of 5 deg. with occasional excursions to 15 deg., but you're looking for the average. If you can't get it right, the main metering circuit probably has a leak or restriction.
9. Let the engine return to idle, and adjust the idle mixture screw until you get an average dwell of 25 deg. while the coolant fan is off. Back the screw out to raise the reading.
10. As a check, unplug the mixture control solenoid connector while observing your tach. If rpm doesn't change by at least 50, the idle air bleed circuit is clogged or leaky.
11. Reconnect the M/C solenoid, run the engine back up to 3,000 rpm for a few seconds, then note dwell. It should average 35 deg. If not, reset the lean mixture screw, then the idle mixture screw. A little RTV will work fine to seal up the idle mix screw cavity.

The Throttle Position Sensor (TPS) tattles to the computer about what the driver's doing with his right foot. It's another thing you shouldn't meddle with unless you have no choice. But if the TPS is defective, or you have to replace the air horn or float bowl, adjust as follows:

1. Drill a 5/64th in. hole in the steel cup plug that covers the TPS adjustment screw. Even though I'm pretty careful, I've cut into the screw head, so watch it.
2. Using a small slide hammer or a self-tapping screw and two screwdrivers for leverage, extract the plug.
3. Disconnect the TPS plug and run three jumper wires between the plug terminals and those of the TPS.
4. Attach a digital voltmeter across the center terminal (B) and the bottom terminal (C).
5. With the ignition on and the engine and A/C off, turn the adjustment screw until you see .26 volts on your meter.

Remember, this is an important setting to the operation of the C-3 system, so get it right. Seal the adjusting screw cavity with a new plug or RTV.

If the choke heater connection is getting 12 volts with the engine running, but the choke isn't opening properly, it's an easy matter to drill out the choke cover rivet heads with a 5/32 in. bit and replace the part. You'll have to make an extension for your pop rivet tool for installation. Use a piece of 1/8 in. steel tubing one inch long. By the way, if voltage to the choke was low or zilch on a vehicle which has a temperature/oil pressure warning light instead of gauges, and the wires and connections are okay, chances are you need a new oil pressure switch.

The float setting, fuel filter, idle stop solenoid, etc. are handled pretty much in the normal manner, and idle speed should be adjusted according to the Emission Control Information Label.

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